

BRIEF DESCRIPTION OF THE DRAWINGS

The invention of the present application will now be described in more detail with reference to preferred embodiments of the apparatus and method, given only by 5 way of example, and with reference to the accompanying drawings, in which:

Fig. 1 is an illustration of a first exemplary embodiment of a tissue acquisition system;

10 Fig. 2 is a schematic illustration of a portion of an inner cannula of the tissue acquisition system illustrated in Fig. 1;

Fig. 3a is a cross-sectional view of the inner cannula illustrated in Fig. 2, taken at line 3-3;

Fig. 3b is a cross-sectional view of an alternate embodiment of the inner cannula illustrated in Fig. 2, taken at line 3-3;

15 Fig. 3c is a cross-sectional view of another alternate embodiment of the inner cannula illustrated in Fig. 2, taken at line 3-3;

Fig. 3d is a cross-sectional view of yet another alternate embodiment of the inner cannula illustrated in Fig. 2, taken at line 3-3;

20 Fig. 3e is a cross-sectional view of another alternate embodiment of the inner cannula illustrated in Fig. 2, taken at line 3-3;

Fig. 4a is a schematic illustration of a portion of an outer cannula of the tissue acquisition system illustrated in Fig. 1;

Fig. 4b is a schematic illustration of a portion of an alternate embodiment of an outer cannula of the tissue acquisition system illustrated in Fig. 1;

25 Fig. 5a is a schematic illustration of a portion of a cutting loop of the tissue acquisition system illustrated in Fig. 1;

Fig. 5b is a schematic illustration of a portion of an alternate embodiment of a cutting loop of the tissue acquisition system illustrated in Fig. 1;

Fig. 5c is a schematic illustration of a portion of another alternate embodiment of a cutting loop of the tissue acquisition system illustrated in Fig. 1;

Fig. 5d is a schematic illustration of a portion of yet another alternate embodiment of a cutting loop of the tissue acquisition system illustrated in Fig. 1;

5 Fig. 6a is a schematic illustration of a distal tip portion of the tissue acquisition system illustrated in Fig. 1;

Fig. 6b is a schematic illustration of portions of an alternate embodiment of the tissue acquisition system illustrated in Fig. 1;

10 Fig. 7 is a schematic illustration of proximal portions of a cannula;

Fig. 8 is a schematic illustration of proximal portions of an inner cannula;

Figs 9-14 are perspective illustrations of a cannula, illustrating an exemplary process of sampling tissue;

Fig. 15 is an illustration of an exemplary process;

Fig. 16 is an illustration of an alternate process;

15 Fig. 17 is an illustration of cuts that can be made in tissue;

Fig. 18 is an end view of yet another exemplary embodiment of a cannula;

Fig. 19 is an illustration of cuts that can be made in tissue;

Fig. 20 is an illustration of yet another embodiment of a cutting loop;

Fig. 21 is a cross-sectional view taken along line 21-21 in Fig. 20; and

20 Fig. 22 is an illustration of yet another embodiment of an outer cannula.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawing figures, like reference numerals designate identical or corresponding elements throughout the several figures.

In Figure 1, a system 100 for sampling or removing tissue from a patient (not illustrated), includes a cannula 102, which is preferably constructed of materials so that it can economically be disposable. System 100 further includes an actuator 104

to which cannula 102 is removably attached. Actuator 104 is preferably non-disposable, i.e., is constructed of materials and includes components which are intended to be reused. Actuator 104 is the interface between cannula 102 and an RF generator 106 and vacuum source 108, and also includes at least two motors (not illustrated): a first motor which rotates an outer cannula (not illustrated in Figure 1; see Figure 4) of the cannula 102, as well as rotates a cutting wire (not illustrated in Figure 1; see Figures 2 and 5a-5d); and a second motor which moves the cutting wire longitudinally. Additionally, actuator 104 includes switches and proximity sensors which provide control signals for controlling the first and second motors, RF generator 106, and vacuum source 108:

Actuator 104 is connected to and in electrical communication with RF generator 106, which is connected to and in electrical communication with a patient return pad 110 for the RF cutting system, described in greater detail below. The switches in actuator 104 (not illustrated) control the application of RF energy by the cannula 102, as described in greater detail below. A motor driver 112 is also connected to actuator 104, and provides power to the motors in actuator 104. Motor driver 112 receives signals from the switches and proximity sensors in actuator 104, which are used as feedback control signals to control the states of the motors.

Vacuum source 108 preferably includes a vacuum pump or other suitable source of vacuum (not illustrated), and is preferably controllable to at least two vacuum pressure levels. The vacuum pump can also be controllable over a continuum of pressure levels. A tissue collector 114, such as a vacuum jar or similar device, is positioned between vacuum source 108 and cannula 102, and collects tissue sampled or removed from a patient which have been drawn from cannula 102 by the vacuum generated by vacuum source 108. Tissue collector 114 can be reusable or, preferably, disposable.